



NOTES RODS

MICROBE OVERVIEW

- Rod shaped bacteria (bacilli), Gram-negative, non-spore forming

BACTEROIDES FRAGILIS

osms.it/bacteroides-fragilis

PATHOLOGY & CAUSES

- Flora of oral cavity, GI tract (primarily large intestine), genitourinary tract of individuals who are biologically female; responsible for variety of infections
- Obligately anaerobic, non-motile
- Beta lactamase positive → resistance to beta lactam antibiotics
- Fastidious → difficult to isolate
- Grows in 20% bile
- Usually involved in widespread polymicrobial anaerobic Gram-negative bacilli infections (AGNB)
 - Intra-abdominal, skin/soft tissue, pulmonary

RISK FACTORS

- Prior antibiotic use
- ↓ blood supply (e.g. trauma, malignancy, surgery, shock, vascular disease)
- Tissue necrosis
- Disruption of intestinal mucosa
- High risk for aspiration pneumonia (e.g. alcoholism, coma, stroke)
- Bronchial obstruction → lung abscesses

SIGNS & SYMPTOMS

- Foul-smelling discharge, tissue necrosis, formation of abscesses, gas production in tissues/discharges

DIAGNOSIS

DIAGNOSTIC IMAGING

CT scan

- Abscesses/presence of gas in infected site
 - Highly suggestive of anaerobic infection

LAB RESULTS

- Rapid enzymatic test
- Polymerase chain reaction (PCR) assays
- Direct needle aspiration

VISIT...

LANZAROTE
Caliente.COM

TREATMENT

MEDICATIONS

- Antimicrobials
 - Recovered anaerobes mixed with aerobic organisms; clindamycin,

metronidazole, carbapenems, tigecycline, beta-lactam/beta-lactamase inhibitors, ceftiofur

SURGERY

- Drain abscesses, relieve obstructions

BARTONELLA HENSELAE

osms.it/bartonella-henselae

PATHOLOGY & CAUSES

- Zoonotic** microbe; affects skin (most common), regional lymph nodes, internal organs (e.g. liver, spleen); small, pleomorphic; fastidious, slow growing; requires specific culture conditions; grows in lysis centrifugation tubes; detected with Warthin–Starry (WS)/silver stain
- Natural reservoir
 - Domestic cats, usually young cats
- Mode of transmission
 - Infection follows cat scratch, bite, exposure to cat feces/fleas

Commonly associated diseases

- Cat-scratch disease (CSD)
 - Usually affects children
- Bacillary angiomatosis (BA)
 - Rare vasoproliferative disorder; usually occurs in severely immunocompromised individuals (e.g. due to HIV)

COMPLICATIONS

CSD

- Lymph nodes necrosis; can disseminate, cause life-threatening complications involving visceral organs (e.g. liver, spleen), central nervous system (CNS), eyes

BA

- Potentially fatal if untreated

SIGNS & SYMPTOMS

- May be asymptomatic

CSD

- Usually develops 1–3 weeks after inoculation
- Regional lymphadenopathy/lymphadenitis (most common)
 - Usually unilateral; lymph nodes drain site of inoculation; tender, swollen lymph nodes
- Rare
 - Low grade fever, malaise, ↓ appetite, abdominal aches
- Cutaneous erythematous lesion at site of inoculation; regresses spontaneously after 1–4 weeks
- Visceral organs → hepatomegaly, splenomegaly
- Eyes → neuroretinitis, parinaud oculoglandular syndrome
- Central nervous system (CNS) → encephalopathy

BA

- Usually affects skin → red papules, nodules/subcutaneous masses

DIAGNOSIS

LAB RESULTS

- Difficult to culture; incubation takes 2–4 weeks
- PCR assays

Biopsy

- CSD: granulomatous inflammation of lymph nodes, stellate microabscesses; organisms visualized using WS/silver stain
- BA: **biopsy of lesions**; Bartonella demonstrated with WS stain

Serologic test

- Indirect immunofluorescence antibody (IFA)/enzyme immunoassay (EIA)

Nonspecific findings

- ↑ erythrocyte sedimentation rate (ESR), ↑ C-reactive protein (CRP) in CSD

OTHER DIAGNOSTICS

- Clinical findings suggestive of *Bartonella* infection with history of contact with cat

TREATMENT

MEDICATIONS**CSD**

- Usually self-limited within 2–4 months; antimicrobial therapy with azithromycin prevents life-threatening complications; alternative agents include doxycycline, rifampin

BA

- Erythromycin, doxycycline, tetracycline



Figure 96.1 The histological appearance of an lymph node excised from an individual with cat-scratch disease. There are numerous neutrophils which form characteristic stellate, or star-shaped, microabscesses.

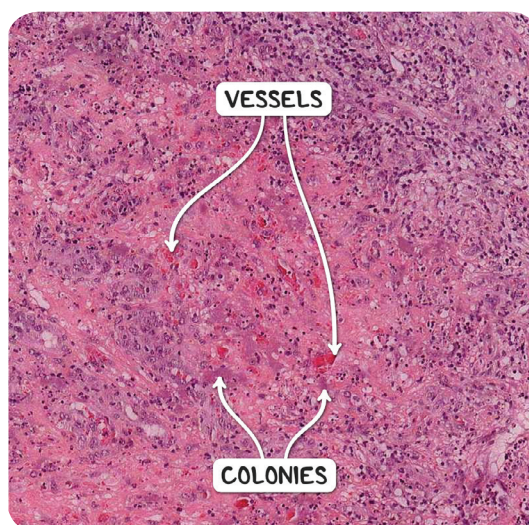


Figure 96.2 The histopathological appearance of bacillary angiomatosis. There is a proliferation of small capillaries surrounded by mixed inflammatory cells, histiocytes and bacterial colonies.

ENTEROBACTER

osms.it/enterobacter

PATHOLOGY & CAUSES

- Opportunistic microbe; nosocomial, various organ system infections; *Enterobacteriaceae* family; motile, nonfastidious; **fast lactose fermenter**, pink colonies on **MacConkey agar** (lactose containing medium); grows in aerobic, anaerobic conditions, rapidly on selective, nonselective agars; expresses fimbria; hemolysin, urease positive
- **Commonly isolated species:** *E. cloacae*, *E. aerogenes*
- Natural reservoir
 - Soil, water, intestinal flora; occasionally respiratory tract
- Mode of transmission
 - **Endogenous:** transfer from flora to adjacent sterile sites
 - **Exogenous:** direct/indirect contact of mucosal surfaces with *Enterobacter*

Commonly associated diseases

- Lower respiratory tract infections
 - Tracheobronchitis, pneumonia, lung abscess, empyema
- Urinary tract infections (UTIs) in hospitalized individuals
 - Cystitis, pyelonephritis, prostatitis
- Bloodstream infections (BSI)
- Skin, soft tissue infections
 - Cellulitis, fasciitis, myositis, skin abscesses, wound infections
- Intra-abdominal infections
 - Abscesses, peritonitis following intestinal perforation/surgery
- Uncommon
 - Endocarditis, septic arthritis, osteomyelitis, CNS, ocular infections

RISK FACTORS

- More common in neonates, elderly individuals

- Prolonged hospitalization
- Invasive procedures (e.g. post-surgery infections)
- Prior antibiotic therapy
- Invasive devices (e.g. venous catheterization)
- Underlying conditions
 - Malignancy, chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), burns
- Mechanical ventilation
- Immunosuppression

COMPLICATIONS

- Septic shock

SIGNS & SYMPTOMS

- Non-specific, depends upon organ system affected
- UTIs
 - Frequency, urgency of urination, dysuria

DIAGNOSIS

DIAGNOSTIC IMAGING

Chest X-ray/CT scan

- Respiratory infections

Abdomen CT scan/ultrasound

- Abdominal infections

LAB RESULTS

- Urinalysis for UTIs

Microbe identification

- Gram staining, culture

TREATMENT

MEDICATIONS

- Antimicrobials
 - Carbapenems, aminoglycosides, fluoroquinolones, trimethoprim-sulfamethoxazole, polymyxins

SURGERY

- Drain abscesses

OTHER INTERVENTIONS

- Remove invasive devices (e.g. central venous catheters)

ESCHERICHIA COLI

osms.it/escherichia-coli

PATHOLOGY & CAUSES

- Frequent cause of variety of infections; Enterobacteriaceae family; encapsulated, motile; certain strains hemolytic (beta-hemolytic on blood agar); **fast lactose fermenter** (pink colonies on MacConkey agar); nonfastidious; beta-galactosidase positive (breaks down lactose into glucose, galactose); iron uptake system
- AKA E.Coli
- Natural reservoir
 - Intestinal, vaginal flora
- Mode of transmission
 - Person-to-person contact, contaminated food/water, dislocation from intestinal tract
- Growing conditions
 - On selective media; aerobic, anaerobic; eosin-methylene blue (EMB) agar for isolation (colonies with green metallic sheen); 15–45°C/59–113°F (some strains more heat resistant)
- Virulence factors
 - Fimbriae, K-capsule, lipopolysaccharides (LPS) endotoxin
- Pathogenic factors
 - Fimbriae → cystitis, pyelonephritis
 - K-capsule → pneumonia, neonatal meningitis
 - LPS endotoxin → septic shock

Commonly associated diseases

- Genitourinary tract infections

- Leading cause of cystitis, pyelonephritis, prostatitis
- Intra-abdominal infections
 - Enteric infections, abscesses, cholecystitis, spontaneous bacterial peritonitis (E. coli most common cause)
- Pneumonia
- Meningitis (in neonates)

TYPES

Enteroinvasive (EIEC)

- Invades intestinal mucosa → **necrosis, inflammation** → dysentery

Enterotoxigenic (ETEC)

- Heat-labile toxin (LT)** → over-activates adenylate cyclase (cAMP) → ↑ Cl⁻ secretion in gut, water efflux
- Heat-stable toxin (ST)** → overactivates guanylate cyclase (cGMP) → ↓ resorption of NaCl, water in gut
- Produces LT, ST → travellers' **diarrhea (watery)**, mimics *Vibrio cholerae* illness

Enteropathogenic (EPEC)

- Adheres to apical surface, flattens villi, **prevents absorption** → diarrhea

Enterohemorrhagic (EHEC)

- Most commonly isolated serotype O157:H7
- Produces **Shiga-like toxin** → enhances cytokine release
 - Necrosis, inflammation → **dysentery**
 - Endothelial damage → formation of microthrombi → hemolysis

(microangiopathic hemolytic anemia), platelet consumption (thrombocytopenia), ↓ renal blood flow (acute renal failure) → **hemolytic uremic syndrome (HUS)**

- O157:H7 most common serotype

SIGNS & SYMPTOMS

- Depends on organ system affected
- Clinical manifestations generally nonspecific, except in enteric infections
 - **EHEC**: bloody diarrhea, malaise, fever
 - **EIEC**: dysentery, mimics shigellosis; bloody diarrhea, abdominal pain, tenesmus
 - **ETEC**: watery diarrhea (travellers' diarrhea), nausea, abdominal pain
 - **EPEC**: fever, watery diarrhea; can last > two weeks; typically affects children

DIAGNOSIS

LAB RESULTS

- Culture to isolate *E. coli*, gram staining, ↑ fecal leukocytes (except ETEC), PCR assays
- Complete blood count
 - Leukocytosis
- Urinalysis in UTIs
- Pyuria
 - Leukocyte esterase + → evidence of white blood cell (WBC) activity
- Proteinuria, bacteriuria
- Nitrite test + → ↓ urinary nitrates → marker of infection

TREATMENT

MEDICATIONS

- Antimicrobial treatment (UTIs, pneumonia, meningitis, intra-abdominal infections, sepsis)
 - Third-generation cephalosporins, quinolones, doxycycline, trimethoprim/sulfamethoxazole (TMP/SMZ)
- Antidiarrheal medications
 - Contraindicated in children, EIEC infections
- EHEC
 - Antibiotics contraindicated; can increase risk of HUS, thrombotic thrombocytopenic purpura (TTP) complications
- ETEC
 - Antibiotics useful; reduce diarrhea duration

OTHER INTERVENTIONS

- Most enteric infections self-limited, managed conservatively
 - Fluid, electrolytes correction

KLEBSIELLA PNEUMONIAE

osms.it/klebsiella-pneumoniae

PATHOLOGY & CAUSES

- Causative agent of infections, usually occur in immunocompromised individuals; major cause of hospital-acquired infections; *Enterobacteriaceae* family, facultative anaerobe, nonmotile; possesses prominent polysaccharide capsule; beta-lactamase positive (resistant to ampicillin, amoxicillin; susceptible to cephalosporins); urease positive, lactose fermenter, iron uptake system
- Natural reservoir
 - Flora of human mouth, intestine; soil, water

Commonly associated diseases

- Pulmonary infections
 - Pneumonia, empyema, lung abscesses, bacteremia
- UTIs
 - Cystitis, pyelonephritis, prostatitis, abscesses
- Pyogenic liver/splenic abscesses
- Infective endocarditis
- Spontaneous bacterial peritonitis
- Endophthalmitis
- CNS infections
- Meningitis, brain abscesses
- Deep neck infections
- Skin, soft tissue infections

RISK FACTORS

- Prolonged hospitalization
- Prior use of antibiotics
- Prolonged use of invasive devices (e.g. catheters)
- Underlying medical conditions
 - Alcoholism, DM, underlying malignancy, hepatobiliary disease, COPD, renal failure
- Use of glucocorticoids

COMPLICATIONS

- Pneumonia can be fatal regardless of treatment

SIGNS & SYMPTOMS

- **Pneumonia** presents as bronchopneumonia/bronchitis (acute onset of symptoms)
 - Productive cough (e.g. mucoid; bloody sputum, AKA “**currant jelly sputum**”), high grade fever, chills, chest pain, dyspnea, tachypnea, crackles
- UTIS (frequency, urgency, dysuria)

DIAGNOSIS

DIAGNOSTIC IMAGING

Chest X-ray

- Findings suggestive of pneumonia

LAB RESULTS

- Complete blood count
 - Leukocytosis
- Specimen culture
 - E.g. blood, sputum, urine
 - **Gram stain**: Gram-negative, rod-shaped capsule appears as clear space

TREATMENT

MEDICATIONS

- Antimicrobial therapy
 - Beta-lactams with beta-lactamase inhibitors, cephalosporins, fluoroquinolones, aminoglycosides, carbapenems

SURGERY

- Drain abscesses
- Debride necrotic issues

LEGIONELLA PNEUMOPHILA

osms.it/legionella-pneumophila

PATHOLOGY & CAUSES

- Gram-negative, facultative intracellular (stain poorly with Gram stain); best visualized by silver stain; appears in specimens as short rod; longer, filamentous in culture; grows best on **charcoal yeast extract medium with cysteine, iron**; serogroup 1 most commonly associated with human infections
- Natural reservoir
 - Water sources (e.g. air conditioning systems, tubing systems of domestic water supplies, water-cooling towers)
- Mode of transmission
 - **Water aerosol inhalation**

Commonly associated diseases

- Legionnaires' disease
 - Atypical form of pneumonia
- Pontiac fever
- Rare self-limited upper respiratory tract infection
- Extrapulmonary disease (rare)
 - Heart most common extrapulmonary site (e.g. myocarditis, endocarditis)

RISK FACTORS

- ↑ age, immunosuppression, smoking, chronic lung disease, organ transplant, renal failure, cardiac disease

COMPLICATIONS

- Pneumonia
 - Progresses rapidly, can be fatal (esp. immunosuppressed individuals)
- Renal failure

SIGNS & SYMPTOMS

Legionnaires' disease

- Incubation period
 - 2–10 days
- Atypical pneumonia
 - Mild cough (may cough bloody mucus), high grade fever, chills, dyspnea, chest pain, rales
- GI
 - Diarrhea, nausea, vomiting, abdominal pain
- CNS
 - Confusion, lethargy, headache, focal neurologic signs, hallucinations

Pontiac fever

- Acute onset
- Mild, febrile, flu-like syndrome

DIAGNOSIS

DIAGNOSTIC IMAGING

Chest X-ray/CT scan

- Legionnaires' disease
 - Unilateral
- Diffuse, patchy inflammation of interstitium → consolidation involving ≥ one lobe

LAB RESULTS

- Nonspecific findings
 - **Hyponatremia**, thrombocytopenia, leukocytosis, hypophosphatemia
- Culture of respiratory specimens
 - Many neutrophils, few microorganisms
- Urinary antigen test using enzyme-linked immunosorbent assay (test of choice along with culture)
 - Rapid; sensitive, specific; legionella persists in urine for weeks

- Fluorescent antibody test on sputum specimens
- Serological tests
 - Serum antibodies develop after 8–10 days; fourfold rise in titre/single high titre
- PCR using sputum/other specimens (less sensitive than culture)

TREATMENT

MEDICATIONS

- Atypical pneumonia
 - **Macrolides**, tetracyclines, fluoroquinolones, rifampicin

OTHER INTERVENTIONS

- Eradication of organism from responsible water source to control disease

NONTYPHOIDAL SALMONELLA

osms.it/nontyphoidal-salmonella

PATHOLOGY & CAUSES

- Causes salmonellosis (foodborne **gastroenteritis**); *Enterobacteriaceae* family; motile; encapsulated; facultative intracellular, anaerobes; nonlactose fermenter; oxidase-; possesses type III secretion system, iron uptake system; high infectious dose; H₂S production on TSI agar; produces endotoxin
- Most common human pathogen
 - *S. enteritidis*
- Natural reservoir
 - **Humans, animals; poultry, eggs, pets, turtles** common sources
- Mode of transmission
 - Food (e.g. undercooked meat, poultry, eggs, milk), fecal-oral route

RISK FACTORS

- Age (usually affects young children, older adults); season (peak incidence in summer, fall); low gastric acidity (atrophic gastritis, use of acid-suppressive agents); immunodeficiency; sickle cell disease; hemolytic anemia; alcoholism; cardiovascular dysfunction; malignancies; IV drug use

COMPLICATIONS

- Can disseminate via blood → extraintestinal manifestations (e.g. endocarditis, vascular infections, cholecystitis, hepatic/splenic abscesses)

SIGNS & SYMPTOMS

- Present 24–48 hours after food ingestion
- Loose stools/**diarrhea** often bloody (can persist for two weeks)
- Nausea, vomiting
- Fever (resolves within two days)
- Abdominal cramps

DIAGNOSIS

LAB RESULTS

- Stool culture, ↑ fecal leukocytes, blood cultures to detect bacteremia; bone marrow aspiration, culture

TREATMENT

MEDICATIONS

- Antimicrobial therapy
 - Generally not required, **prolongs duration of fecal shedding** of *Salmonella*, doesn't shorten duration of symptoms

- Antibiotics
 - Only indicated in immunocompromised individuals; antimicrobial agents (e.g. ciprofloxacin)

PROTEUS MIRABILIS

osms.it/proteus-mirabilis

PATHOLOGY & CAUSES

- Common cause of community acquired, nosocomial UTIs (e.g. primarily cystitis, pyelonephritis)
- Enterobacteriaceae family; highly motile; nonlactose fermenters; oxidase negative; expresses mannose-resistant hemagglutination, calcium dependent/independent hemolysins; swarming growth in discontinuous manner on agar media; H₂S production on TSI agar; resistance to polymyxins, tetracyclines
- Urease positive → converts urea to ammonia, CO₂ → ↑ urine pH → ammonia combines with magnesium, phosphate → form magnesium-ammonium-phosphate (struvite) stones
- *Pr. mirabilis* causes 90% of infections
- Natural reservoir
 - Intestinal flora
- Virulence factors
 - Fimbria (important for adherence to tissue)

Commonly associated diseases

- Urethritis, acute prostatitis, pyogenic liver abscesses

RISK FACTORS

- Hospitalization; ↑ age (most common in elderly); multiple prior UTIs; prior use of antibiotics; urinary tract surgery; urinary catheterization; structural abnormalities/obstructions of urinary tract; underlying medical conditions (e.g. DM, chronic kidney disease); neurogenic bladder; frequent sexual activity

COMPLICATIONS

- Abscesses, sepsis, meningitis, chronic pyelonephritis, xanthogranulomatous pyelonephritis (chronic destructive granulomatous process of renal parenchyma)

SIGNS & SYMPTOMS

- Nonspecific, disease-dependent: symptoms commonly associated with urethritis, acute prostatitis, pyogenic liver abscesses

DIAGNOSIS

DIAGNOSTIC IMAGING

Ultrasound/CT scan

- Kidneys; indicated if therapy fails

X-ray

- Struvite stones appear radiopaque

LAB RESULTS

- Urine culture to isolate *Proteus*
- Complete blood count
 - Leukocytosis
- Urinalysis
 - Alkaline urine pH (> 7.0), pyuria, bacteriuria

TREATMENT

MEDICATIONS

- Uncomplicated UTIs
 - *Cystitis*: TMP/SMX, nitrofurantoin, quinolones, fosfomycin
 - *Pyelonephritis*: quinolone/ampicillin, gentamicin/third-generation cephalosporin
- Complicated UTIs
 - E.g. diabetes, nephrolithiasis, pregnancy, anatomic abnormalities of urinary tract
 - Therapy should be prolonged

SURGERY

- Drainage of collections (e.g. perinephric abscesses)
- Removal of struvite renal calculus



Figure 96.3 *Proteus* species spread in a swarming fashion on an agar plate.

PSEUDOMONAS AERUGINOSA

osms.it/pseudomonas-aeruginosa

PATHOLOGY & CAUSES

- One of most common causes of hospital-acquired infections in immunocompromised individuals; motile; aerobic; nonlactose fermenter (derives energy from carbohydrates by oxidation); nonfastidious; oxidase, catalase, elastase, leukocidin, hemolysin positive; resistant to many antibiotics
- Grows on variety of culture media
 - Colonies greenish-blue due to production of procyanin (blue), pyoverdinin (yellow-green); fruity, grape-like odor
- Natural reservoir
 - Water, soil sources (e.g. rivers, ponds), animals, plants, hospital equipment; hospitalized individuals asymptomatic carriers
- Mode of transmission
 - Direct contact with contaminated materials/infected individuals

- Virulence factors
 - Exotoxin A → inactivates elongation factor (EF-2) → inhibition of protein synthesis → death of host cells
 - Phospholipase C → degrades membranes
 - Endotoxin → fever, shock
 - Mucoid exopolysaccharide → biofilm formation → protection from immune system

Commonly associated diseases

- Pneumonia; sepsis; genitourinary tract infections; skin, soft tissue infections; ear infections (e.g. external otitis, chronic otitis media); eye infections (e.g. keratitis); GI infections; bone, joint infections (usually affects vertebral column); infective endocarditis

RISK FACTORS

- Prolonged hospitalization, catheterization, IV drug use, severe burns, contact lenses, eye trauma

- Mechanical ventilation/endotracheal intubation
 - *P. aeruginosa* second most common cause of ventilator-associated pneumonia
- Cystic fibrosis (CF) → chronic infection with *P. aeruginosa*
- Immune system deficits (e.g. neutropenia, diabetes)

COMPLICATIONS

- Sepsis/necrotizing pneumonia can be fatal in immunocompromised individuals
- Chronic infections in CF → bronchiectasis, pulmonary fibrosis → pulmonary failure
- Disseminated intravascular coagulation due to sepsis
- Eye infections → vision loss

SIGNS & SYMPTOMS

- Generally nonspecific, depend on organ system
- Eye infections (esp. cornea) extremely painful, rapidly destructive
- Ecthyma gangrenosum
 - Due to sepsis, typically appears in immunocompromised individuals
 - Well-demarcated, black, necrotic cutaneous lesion; rapidly progressive

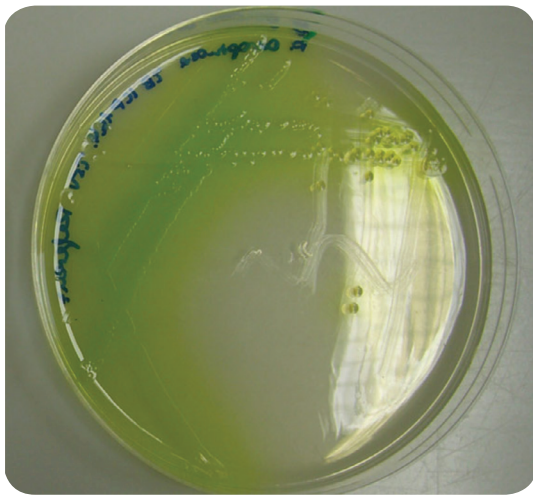


Figure 96.4 *Pseudomonas* species will adopt a greenish hue when cultured on cetrimide agar.

DIAGNOSIS

DIAGNOSTIC IMAGING

Chest X-ray

- Pneumonia
 - Bilateral bronchopneumonia with nodular infiltrates with/without pleural effusion

LAB RESULTS

- Culture (blood/other specimens) on selective media
 - Enhances production of procyanin
- Oxidase test
- PCR assays
- Complete blood count
 - Leukocytosis
- Serological tests
 - Only individuals with CF/COPD

TREATMENT

MEDICATIONS

- Antimicrobial therapy
 - Extended-spectrum penicillins, beta-lactamase inhibitors, aminoglycosides, carbapenems, monobactams, polymyxins, fluoroquinolones, third/fourth-generation cephalosporins

SERRATIA MARCESCENS

osms.it/serratia-marcescens

PATHOLOGY & CAUSES

- Opportunistic microbe; uncommon cause of variety of hospital-acquired infections; Enterobacteriaceae family; motile; aerobic; slow, weak lactose fermenter; urease positive (struvite stones in individuals with recurrent UTIs); catalase positive; grows on media at 30–37°C/86–99°F, utilize most carbohydrates with production of acid, gas; produces **red pigment** (prodigiosin) colonies on agar; often resistant to commonly used antibiotics (e.g. ampicillin, macrolides, first-generation cephalosporins)
- Natural reservoir
 - Water, soil sources
- Virulence factors
 - Fimbria, cell surface components, long-chain LPS, hemolysin

Commonly associated diseases

- Respiratory infections (e.g. pneumonia), UTIs, wound infections, CNS infections (e.g. meningitis, cerebral abscesses), intra-abdominal infections, septicemia, endocarditis, otitis externa

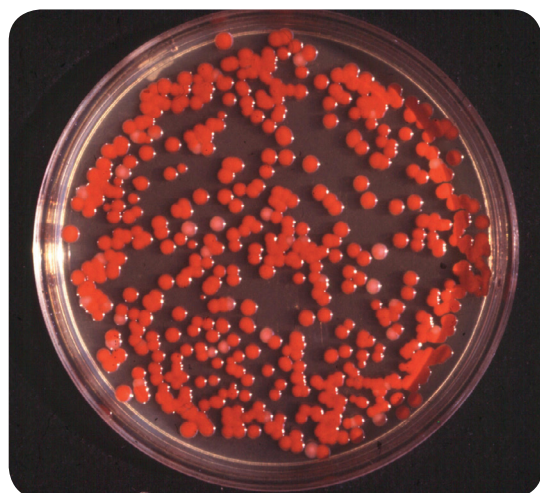


Figure 96.5 *Serratia marcescens* grows red colonies when cultured on agar.

RISK FACTORS

- Neonates, infants
- More common in individuals who are biologically male
- Prolonged hospitalization; catheterization (e.g. intravenous, urinary catheters); mechanical ventilation; recent surgery/obstruction of urinary tract; cardiac valve replacement; IV drug use; immune system deficits (e.g. neutropenia, chronic granulomatous disease, DM); head trauma/brain surgery; contact lenses

COMPLICATIONS

- Septic shock, stroke (due to endocarditis)

SIGNS & SYMPTOMS

- Nonspecific, depend upon disease
- Symptoms associated with respiratory infections, UTIs, wound infections, CNS infections, intra-abdominal infections, septicemia, endocarditis, otitis externa

DIAGNOSIS

DIAGNOSTICS IMAGING

Chest X-ray

- Pneumonia

Abdominal ultrasound/CT scan

- Abnormalities of urinary tract, intra-abdominal infections, abscesses

Echocardiography

- Valvular vegetations

Brain CT scan

- Follow with lumbar puncture in individuals with suspected meningitis

LAB RESULTS

- Complete blood count
 - Leukocytosis, ↑ neutrophils with left shift, possible anemia

TREATMENT

MEDICATIONS

- Antibiotic therapy
 - Aminoglycosides with antipseudomonal beta-lactam
 - If infection persists, fluoroquinolones/carbapenems

SURGERY

- Drainage of collections (e.g. abscesses)

SHIGELLA

osms.it/shigella

PATHOLOGY & CAUSES

- Causes acute infectious diarrhea (shigellosis), one of most common causes of bloody diarrhea; *Enterobacteriaceae* family; facultative anaerobe; nonmotile; nonlactose fermenter; urease, oxidase negative; resistance to low pH of gastric acids; highly virulent; possesses virulence plasmids; invades colonic mucosa via microfold (M) cells of Peyer patches
- Natural reservoir
 - Human only; part of intestinal tract flora
- Mode of transmission
 - Usually fecal-oral route, contaminated water, food; easy person-to-person spread

TYPES

- *S. dysenteriae*: serogroup A
 - Releases Shiga toxin, causes most severe form of shigellosis
- *S. flexneri*: serogroup B
- *S. boydii*: serogroup C
- *S. sonnei*: serogroup D

COMPLICATIONS

- Dehydration (due to fluid loss)
- Electrolyte imbalance (e.g. hyponatremia,

hypokalemia)

- Reiter's syndrome
 - Reactive arthritis, urethritis, conjunctivitis
 - Affects HLA-B27+ individuals
- Hemolytic-uremic syndrome
 - Hemolytic anemia, thrombocytopenia, acute renal failure
 - Usually in infections due to *S. dysenteriae*
- Toxic megacolon
- Intestinal obstruction

SIGNS & SYMPTOMS

- Incubation period
 - 2–3 days/one week
- Sudden onset
 - Abdominal pain
 - Diarrhea that is initially watery, progresses to bloody (bacillary dysentery) in 50% of cases
 - Tenesmus
 - Fever, malaise, headache, anorexia
- Less common
 - Nausea, vomiting

- Subacute presentation in minority of individuals
 - Several weeks of waxing/waning diarrhea

DIAGNOSIS

DIAGNOSTIC IMAGING

Colonoscopy

- Hemorrhagic, ulcerated mucosa
- Most prominent in left colon, ileum also involved
- Pseudomembranes

LAB RESULTS

- Stool culture
- ↑ leukocytes, blood in feces
- PCR testing of stools

TREATMENT

MEDICATIONS

- Antimicrobial therapy
 - Shorten duration of symptoms, reduce fecal shedding of organisms, risk of complications; azithromycin orally, third-generation cephalosporin parenterally
- Antidiarrheal medications contraindicated
 - Delay fecal shedding of *Shigella*

OTHER INTERVENTIONS

- Most cases self limited (resolve within one week), do not require antibiotics

YERSINIA MARCESCENS

osms.it/yersinia-marcescens

PATHOLOGY & CAUSES

- Enterobacteriaceae family; facultative anaerobe, intracellular; motility depends on temperature (motile at 25°C/77°F, nonmotile at 37°C/99°F); nonlactose fermenter; oxidase negative
- Important human pathogens
 - *Y. pestis*, *Y. enterocolitica*
- Natural reservoir
 - *Y. pestis*: ground squirrels, gerbils, voles, rats
 - *Y. enterocolitica*: cattle, deer, pigs, birds, pigs
- Virulence factors
 - Adhesins to bind to host cell beta 1 integrins, endotoxin, coagulase, fibrinolysin, iron uptake system (mediates iron capture, transport)

TYPES

Yersinia enterocolitica

- Causes yersiniosis
 - Gastrointestinal infections (e.g. ileum, appendix, right colon)
- Common types
 - Enterocolitis, terminal ileitis, mesenteric lymphadenitis, pseudoappendicitis
- Mode of transmission
 - Pet feces, inadequately cooked foods, contaminated pork, milk, water

Yersinia pestis

- Causes human plague
 - Zoonotic infection, highly fatal if untreated
- Subtypes
 - Wild (sylvatic), urban plague (typically transmitted from rats, more severe)

- Clinical forms
 - Bubonic (more common), septicaemic, pneumonic (least common, high mortality rate)
- Mode of transmission
 - Fleas from rats, other rodents

COMPLICATIONS

Yersinia enterocolitica

- Reiter's syndrome, myocarditis, erythema nodosum, kidney disease, mucosal ulceration, bowel necrosis (due to mesenteric vessel thrombosis), septicemia (fatal if untreated)

Yersinia pestis

- Bubonic **plague** → sepsis → secondary pneumonic plague/meningitis
- Systemic plague → hypotension, disseminated intravascular coagulation, multiorgan failure
- Pneumonic plague (rapidly fatal if untreated)

SIGNS & SYMPTOMS

Yersinia enterocolitica

- Enterocolitis (most common)
 - Abdominal pain, acute diarrhea, low grade fever, nausea, vomiting
- Abdominal tenderness
 - Right lower quadrant, mimics appendicitis (pseudoappendicitis)
- Extraintestinal features of pharyngitis, arthralgia, erythema nodosum (painful, red/purple lesions, resolve spontaneously)

Yersinia pestis

- Incubation period
 - 2–8 days
- Bubonic plague (sudden onset)
 - fever; painful lymphadenopathy (bubos), inguinal lymph nodes frequently involved; chills, fatigue
- Septicemic plague
 - Fever; malaise, GI symptoms (nausea, vomiting, diarrhea)

- Pneumonic plague (sudden onset):
 - Dyspnea, high grade fever, chest pain, cough with blood-containing sputum

DIAGNOSIS

DIAGNOSTIC IMAGING

Ultrasound/CT scan

- *Yersinia enterocolitica*: exclude appendicitis

Colonoscopy

- *Yersinia enterocolitica*: aphthoid lesions in cecum; elevations, ulcers in terminal ileum

Chest X-ray

- *Yersinia pestis*: pneumonic plague

LAB RESULTS

Yersinia enterocolitica

- Identification of microbe
- Stool culture
 - Cefsulodin-irgasan-novobiocin (CIN) agar
 - In extraintestinal disease, cultures of lymph nodes/blood may be positive
- PCR assays
- ↑ leukocytes in stool, blood
- Serological tests
 - Tube agglutination, enzyme-linked immunosorbent assay (ELISA)

Yersinia pestis

- Nonspecific findings
 - Leukocytosis, thrombocytopenia
- Isolation of organism in blood culture
 - Positive cultures in individuals with bubonic, septicemic plague
- Peripheral blood smear
 - Wright–Giemsa stain reveals rod-shaped bacteria, Wayson stain reveals characteristic “safety pin” appearance
- Rapid antigen testing in sputum/serum
- Serological tests
 - Fourfold rise in serum antibody titers between acute, convalescent phase
- PCR assays

OTHER DIAGNOSTICS

Yersinia pestis

- Clinical findings suggestive of plague, history of traveling to plague-endemic areas

TREATMENT

MEDICATIONS

Yersinia enterocolitica

- Antimicrobial therapy
 - TMP/SMX, aminoglycosides
 - **Alternative agents:** third-generation cephalosporins, tetracyclines, fluoroquinolones

Yersinia pestis

- Antimicrobial therapy
 - Aminoglycosides (streptomycin/gentamicin)
 - **Alternative agents:** doxycycline, tetracycline, fluoroquinolones, chloramphenicol

OTHER INTERVENTIONS

Yersinia enterocolitica

- ↑ fluid intake, good nutrition



Figure 96.6 The black, necrotic fingers of a man infected with *Yersinia pestis*.